Customer Focus Meeting 2022

USDA-ARS Central Great Plains Research Station

Akron, Colorado

Hosted by CSU Extension

March 25, 2022

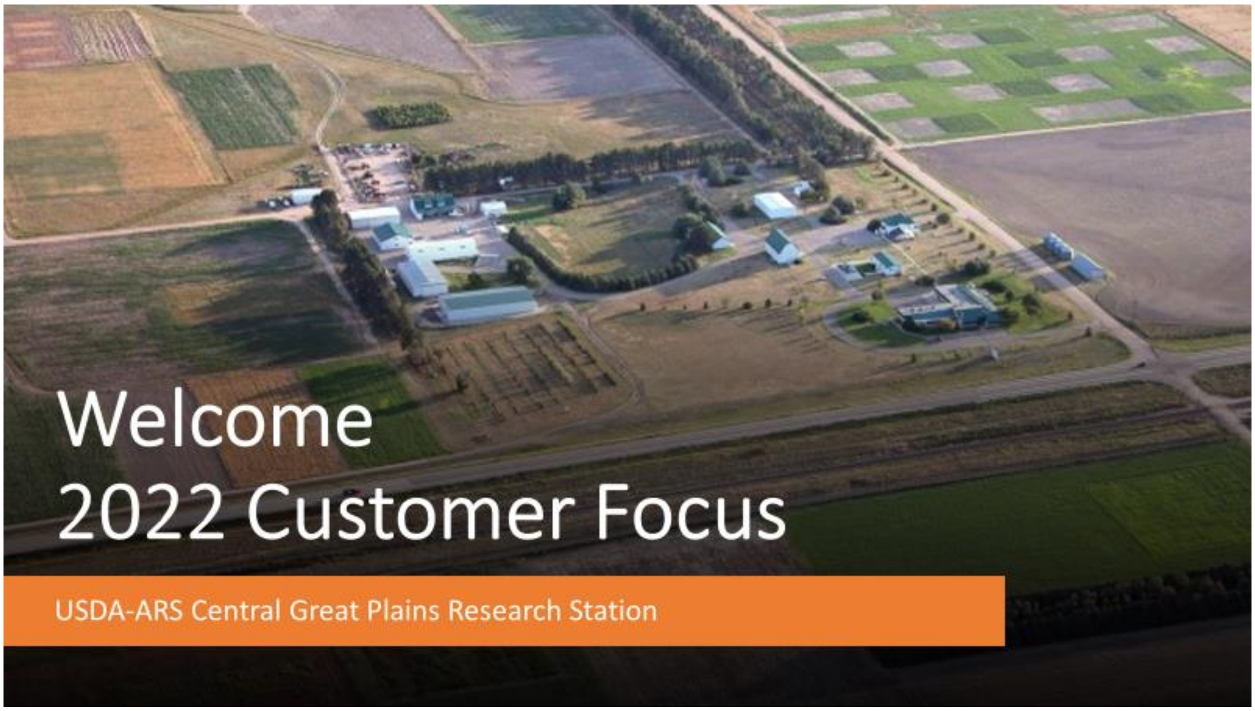
USDA Agricultural Research Service

Colorado State University

Contents

Mission Statement – USDA-ARS Central Great Plains Research Station

To enhance the economic and environmental well-being of agriculture by development of integrated cropping systems and technologies for optimal utilization of soil and water resources. Emphasis is on efficient use of plant nutrients, pesticides, and water and soil conservation/preservation practices.



Our Staff

Scientists

Dr. Kyle Mankin, Research Leader (acting), Agricultural Engineer
Dr. Peter Kleinman, Research Leader, Soil Management & Sugar Beet Research Unit
Dr. Maysoon Mikha, Soil Scientist

Support Scientist

David Poss, Soil Scientist

Technicians

Paul Campbell, Biological Science Tech.
Cody Hardy, Agricultural Sci. Research Tech.
Tyler Pokoski, Agricultural Sci. Research Tech.
Stacey Poland, Agricultural Sci. Research Tech.
Kelsey Strand, Biological Science Lab Tech.
Tyler Untiedt, Agricultural Sci. Research Tech.

Administrative

Travis Vagher, Administrative Officer (acting)
Carolyn Brandon, Secretary Office Automation

Seasonal Technicians

Shay Benish (CSU)
Sarah Clarkson (CSU)
Anthony Dreher
Levi Kipp (CSU)
Cameron Lyon
Syvanna McGuire (CSU)
Susan Pieper
Sara Wylie (CSU)

CSU Staff

Dr. Joel Schneekloth
Ed Asfeld
Sally Jones-Diamond

Agenda

2022 Akron Research Customer Focus Group Meeting
Friday, March 25, 2025, 10:00 a.m. - 3:30 p.m.
Event Center and Fairgrounds, Akron, Colorado

10:00 Welcome, Introductions
Joel Schneekloth (CSU)
Kyle Mankin (Acting Research Leader, CGPRS, Akron; Research Leader, WMSRU, Fort Collins)
Peter Kleinman (Research Leader, SMSBRU, Fort Collins)
Daren Harmel (Director, Center for Agricultural Resources Research, Fort Collins)

10:15 Rye Variety Trials
Dave Poss (USDA-ARS, Akron)

10:25 Weather Update
Wayne Shawcroft (Collaborator)

10:35 Akron Drone Data Program
UAV Team (USDA-ARS, Akron/Fort Collins)

10:50 Wheat Stem Sawfly Research
Esten Mason (CSU)

11:05 Intensifying Row Spacing, Irrigated Corn
Jorge Delgado (USDA-ARS, Fort Collins)

11:25 Sorghum Variety Trials
Sally Jones-Diamond (CSU)

11:40 ACR (Alternative Crop Rotations) Study Analysis
Grace Miner (USDA-ARS, Fort Collins)

12:00 LUNCH

1:00 Setting the Stage: Akron's USDA Research Program
A commitment to solving the challenges facing dryland farmers
Kyle Mankin and Pete Kleinman (USDA-ARS, Akron/Fort Collins)

1:20 Facilitated Discussion
Alan Linnebur, Moderator (Chair, Akron Customer Focus Group)

Thoughts for discussion:

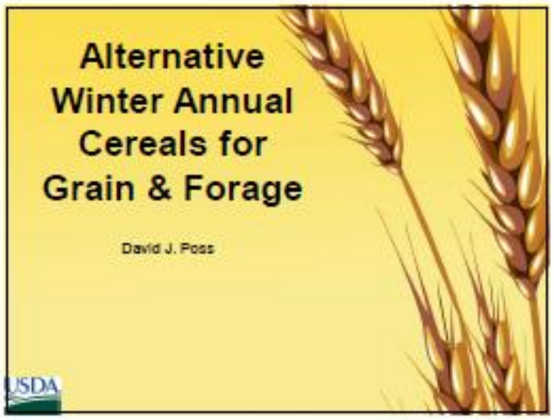
1. "Precision Farming" is essentially figuring out how to make science-based decisions at the appropriate scale. What decisions and scales should research focus on next?
2. Where are there opportunities for research to help producers "find economic value from big data"? How can precision ag/big data help identify the most limiting factors in soil/fertility/precipitation/etc.?
3. Basic vs applied research and the role of ARS Scientists and farmers/ag business. What balance is right for ARS in our region?
4. Are we in soil microbiome kindergarten? Where will it go? What are the Rumsfeld "Known Unknowns", etc.? Most productive opportunities now?
5. What's the best way to communicate with you?

3:30 Adjourn

Rye Variety Trials

David J. Poss

USDA-ARS, Central Great Plains Research Station, Akron, CO



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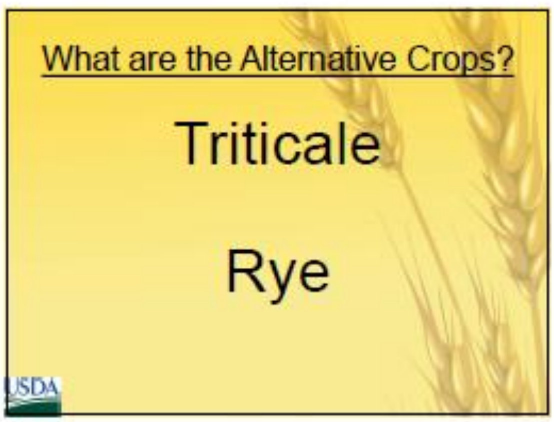

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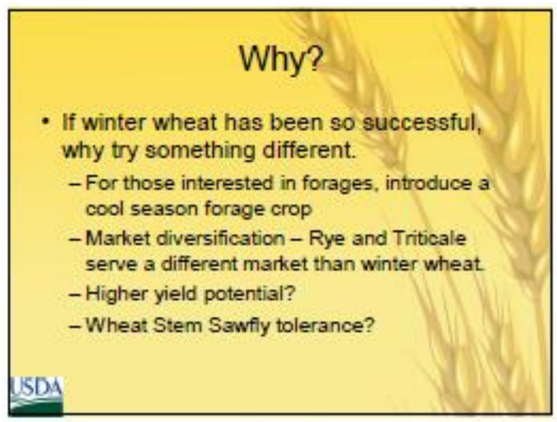

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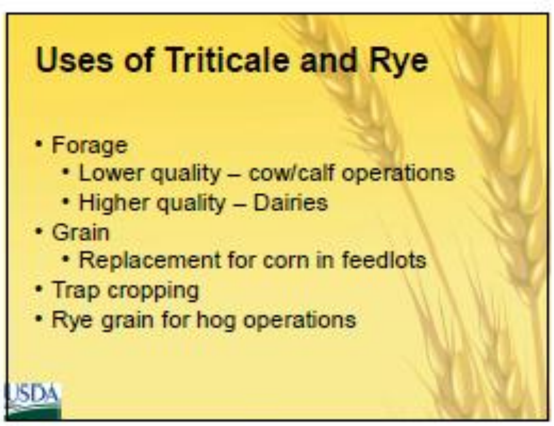

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Plot details

- Seeding dates
  - 2016-17 = October 4, 2016
  - 2017-18 = October 19, 2017
  - 2018-19 = October 18, 2018
- Seeding rate = 50 lbs/ac
- Row spacing = 7.5"
- Plot dimensions = 30' X 15'

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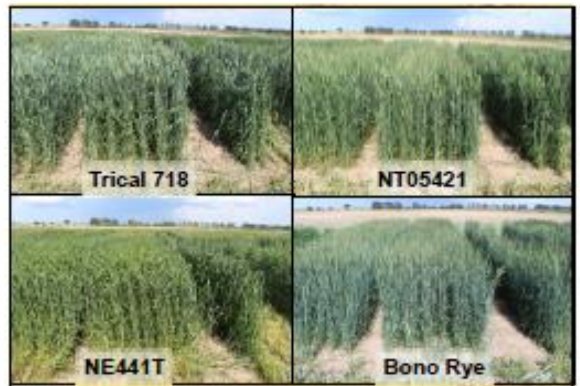

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Mean Forage Yields

Mean across all varieties

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What about grain yield compared to wheat?

- 2017, 2018, & 2019 wheat was not included in the trial
- Compared to other fields on the station
  - Triticale grain yields somewhat less than wheat
  - Rye grain yields significantly greater than wheat -- 25-50%
- 2019 – We added a good CSU wheat cultivar to the trial

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Triticale, Rye, and Wheat Grain Yield in 2021

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Triticale, Rye, and Wheat **Grain** Yield in 2021

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What about Volunteer?

- KWS seeds claims no more than with wheat
- We have not had any issues after three years
- Be cautious
  - Plant for forage
  - Be sure you can kill it in the next 1 or 2 crops
    - Fallow
    - Clearfield technology

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Volunteer Rye Study

- Established fall 2021
- Three rotations
  - Wheat (Rye)-Corn-Millet-Fallow
  - Wheat (Rye)-Corn-Fallow
  - Continuous winter annual cropping
    - Wheat(Rye)
- Monitor volunteer rye in wheat

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Future Plans

- Due to dry fall, trial not planted in fall 2021, postponed to fall 2022
- Pursue purchasing a drill that will penetrate dry, no-till conditions
- Continue collaboration with U. of NE, KWS, and Trical

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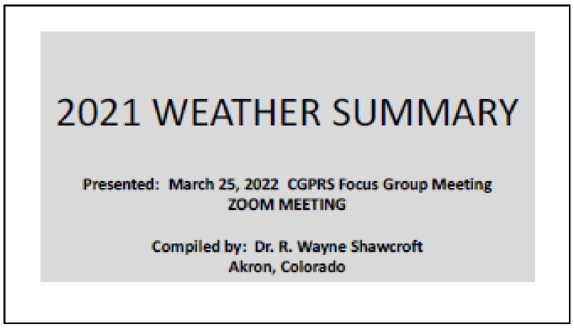
2021 Weather Summary:
Central Great Plains Research Station, Akron, Colorado

Dr. R. Wayne Shawcroft

Regional Extension Irrigation Agronomist (Retired)
Colorado State University



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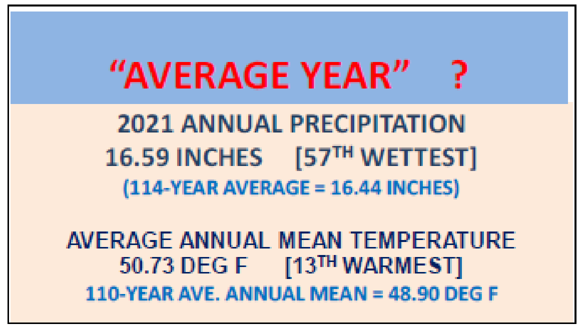

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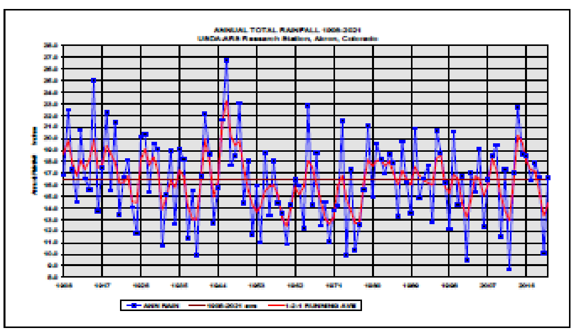

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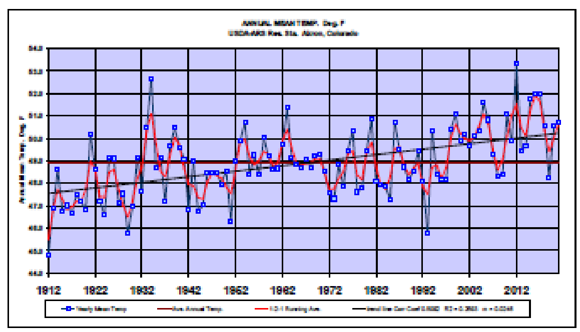

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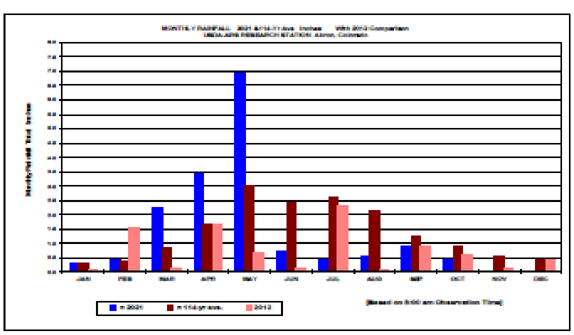

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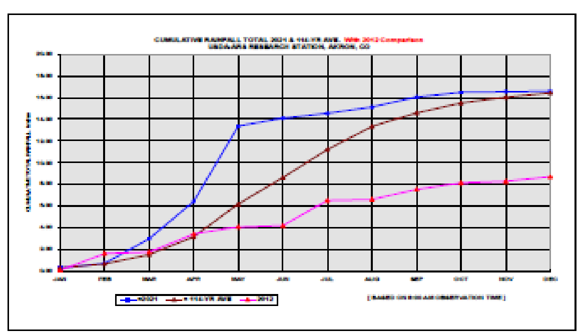

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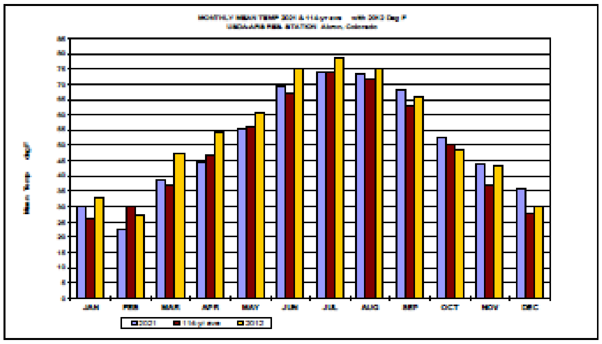

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Rainfall Distribution
81% or 13.38 inches
by the end of May

JAN-MAY PERIOD
3 of the 5 months had AVE. MONTHLY MEAN
BELOW the Long-term Average

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JUNE-DECEMBER RAINFALL
ALL 7 MONTHS BELOW AVERAGE

JUNE-DECEMBER MONTHLY AVERAGE
TEMPERATURES
ALL 7 MONTHS ABOVE AVERAGE

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2021 WEATHER YEAR
DESIGNATED AS....

THE

" 5 BY 7 " YEAR

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JAN-MAY 5-MONTH PRECIPITATION
13.38 inches
Ranked as: 2nd WETTEST of 114-year Record
(114-YEAR AVE. = 6.21 inches)

JUNE-DECEMBER 7-MONTH PRECIPITATION
3.21 inches
Ranked as: DRIEST of 114-Record
(114-YEAR AVE. = 10.23 inches ...62% of Annual Ave.)

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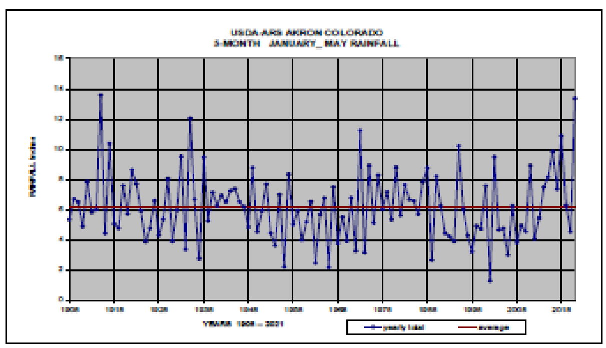

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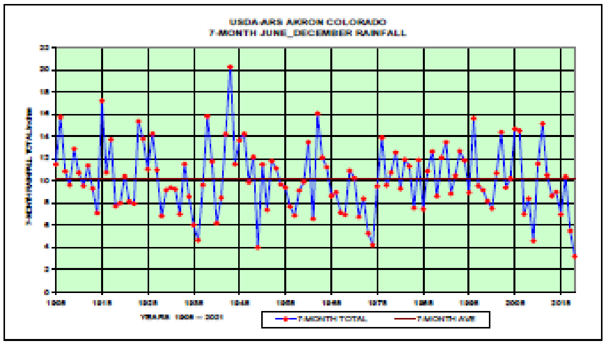

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JAN-MAY 5- MONTH MEAN TEMPERATURE

38.24 deg F

Ranked as: 38th Coldest..or..74th warmest

111-Year Ave. = 39.22 deg F

JUNE-DECEMBER 7-MONTH MEAN TEMP.

59.65 deg F

RANKED AS: WARMEST of RECORD

111-Year Ave. = 55.81 deg F

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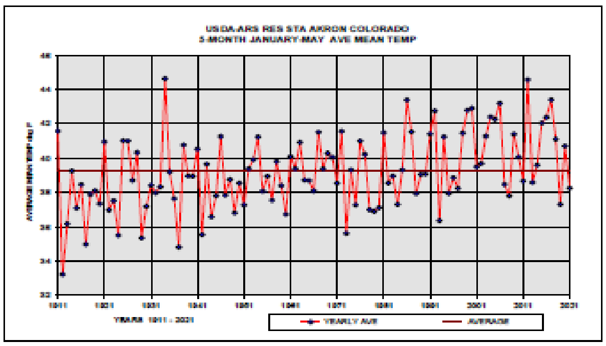

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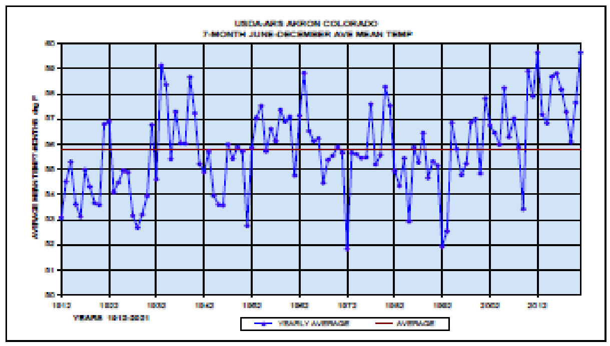

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AKRON DATA 2021

<u>26 RECORDS SET or TIED</u>

15 new high temperature records

Sept. 4th Warmest ...record Max of 91 27th , 90 max on 28th

Nov. 4th Warmest;

Dec. Tie 3rd Warmest

75 deg Max on Dec. 3rd Tied for All-Time Record for Dec.

Dec. 2021 Ave. Maximum 51.85 deg F NEW RECORD

(11.36 DEG F ABOVE THE AVERAGE)

<u>11 new low temperature records</u>

Feb. 13th – 16th ...Four new Record low Maximums including -1 & -5

New Record low minimum of -24 on 14th

Two new Record low means of -5.5 & -14.5 on 14th & 15th

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RAINFALL NOTES 2021

MAY 6.94 inches 3rd Wettest

July 0.46 inches 6th Driest

August 0.57 inches 12th Driest

Nov. (one rain) & Dec. 0.05 inches each:

with only 0.7 inches of snow total

2021 Calendar Year SNOW 26.1 inches

Winter (Jan-May) 25.4 in.

Fall (Sept-Dec) 0.70 in.

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Highest Maximum 101 deg F
101 deg F June 16th : 100 deg F July 8th

Number of days 90 or above = 52
(Ranks tied for 16th in number 90-plus days or 34% of days)
(Average number 90 or above = 44)

Number of minimums 55 or less = 74
(Average number 55 or less = 98)
[Fewer number 55 or less implies WARMER minimums]

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GROWING DEGREE-DAY INDEX

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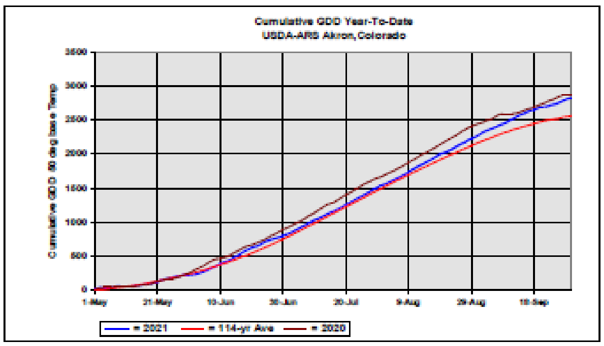

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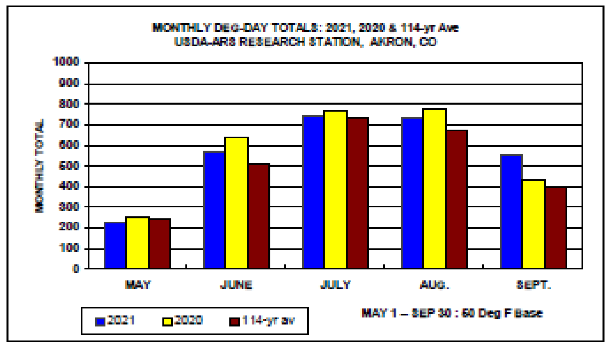

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FROST FREE PERIOD (32 deg)

155 days May 12-October 14
Ranked as the **24th** longest frost-free period
(14 days longer than ave: Average is 141 days)
The range is from 76 days in 1910 to 179 days in 1949
Last 32 deg AVERAGE-date May 11
First 32 deg AVERAGE-date Sept. 30

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2022 PREDICTION

Storm Track Improved ??
(Mountains vs. Plains) ??

Heat, Temps. Wind ??

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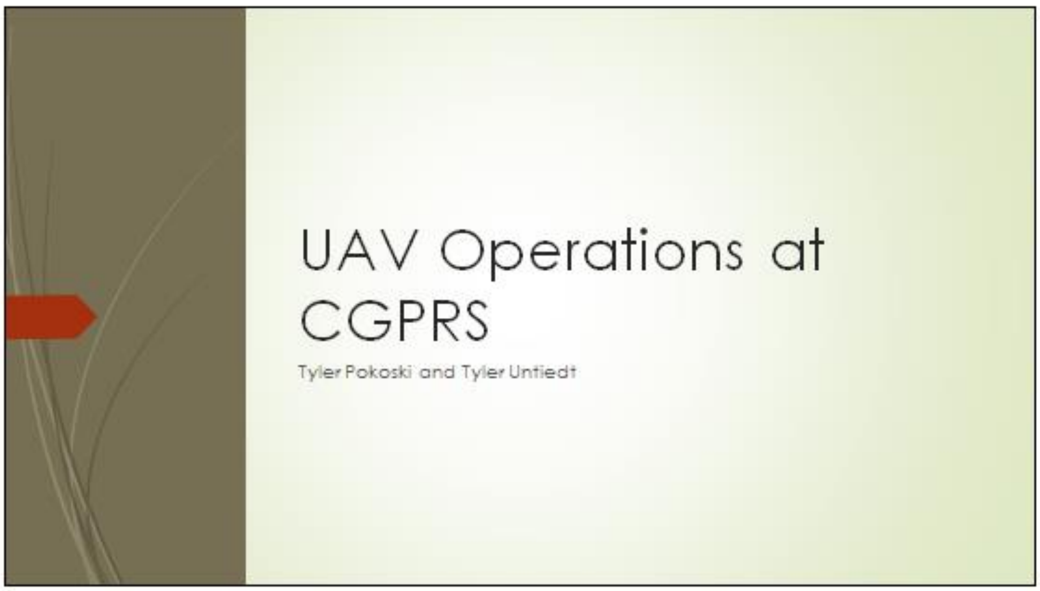
Akron Drone Data Program

Tyler Pokoski, Tyler Untiedt

Agricultural Science Research Technicians
USDA-ARS, Central Great Plains Research Station, Akron, CO

Dr. Huihui Zhang, Kevin Yemoto

Research Physical Scientist, Engineering Technicians
USDA-ARS, Water Management & Systems Research Unit, Fort Collins, CO



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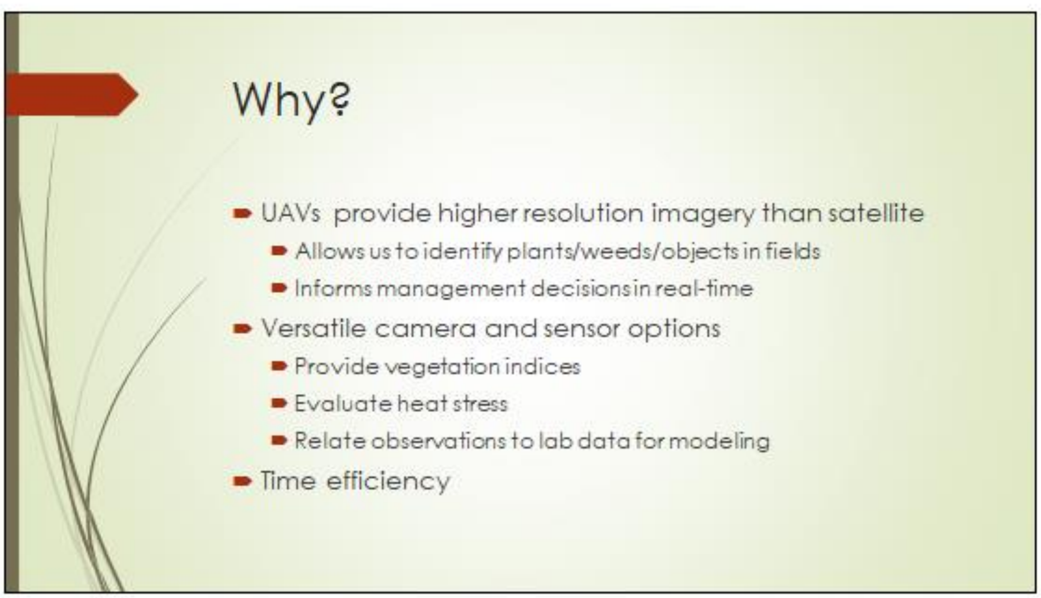

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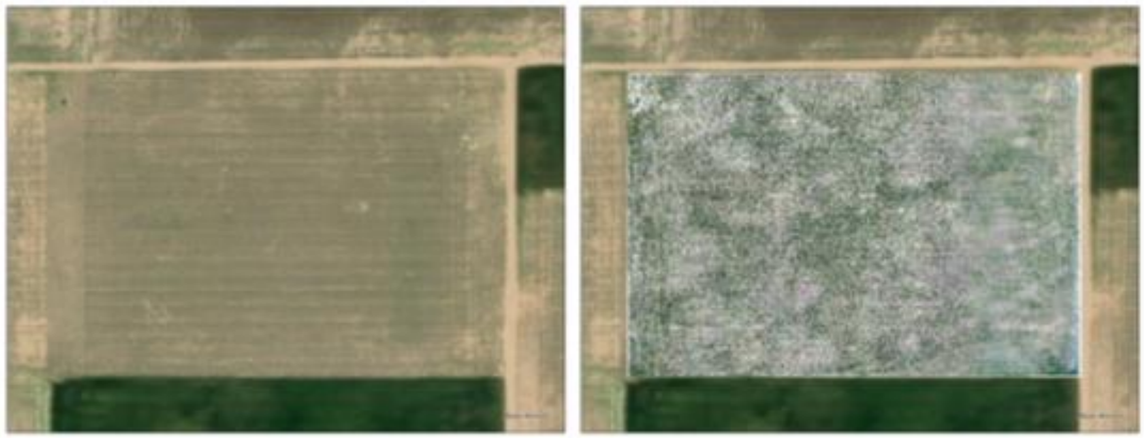
Base Satellite + RGB (Full extent)



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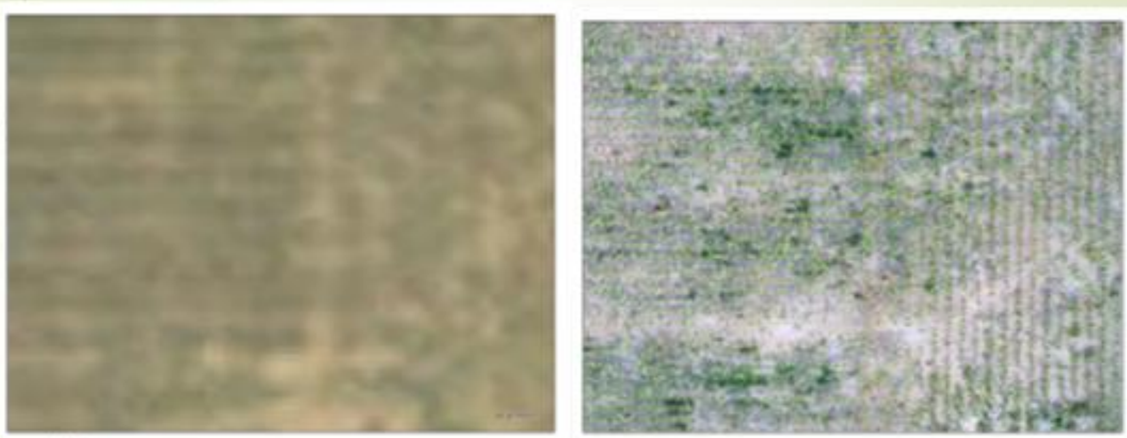
Satellite + RGB (Zoom)



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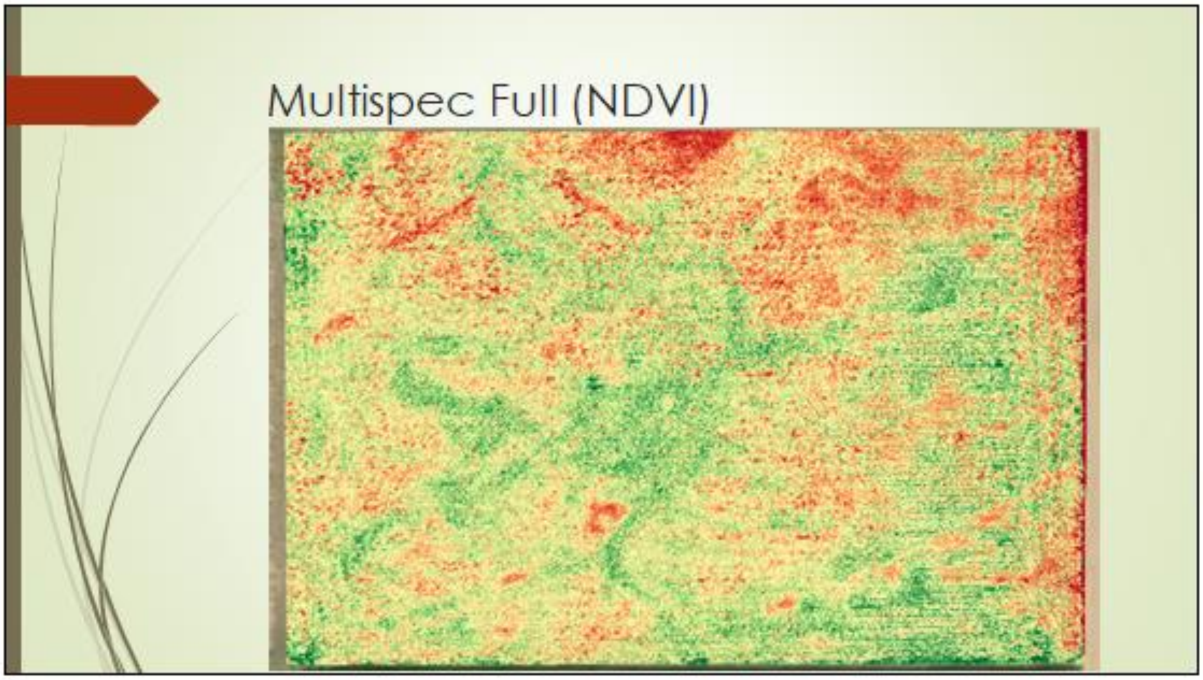

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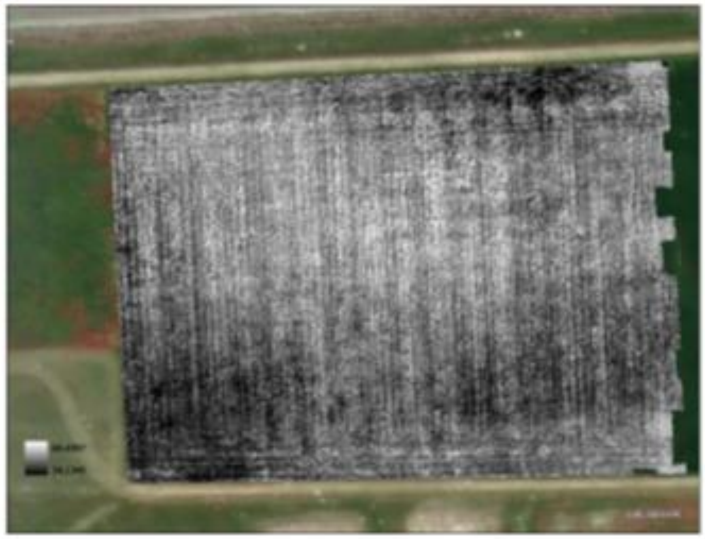
Infrared



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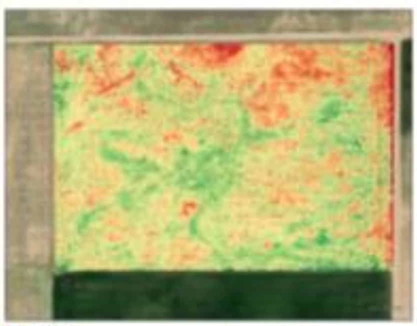
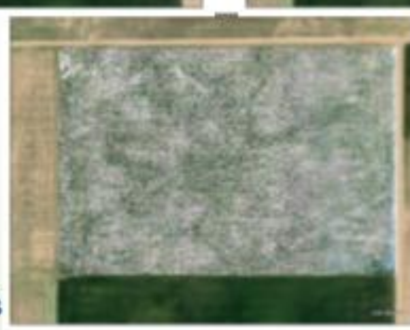


NDVI

Infrared



RGB

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Future Plans

- 2022 Season
  - NASA Collaboration on satellite reflectance project
  - Variable Nitrogen and Irrigation plot experiments
  - Long-term rotational crop experiments
- Beyond 2022
  - Increasing Flight Frequency
  - LiDAR
  - 'Farm of the Future'

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Questions and Contact Info

- Tyler Pokoski – tyler.pokoski@usda.gov
- Tyler Untiedt – tyler.untiedt@usda.gov

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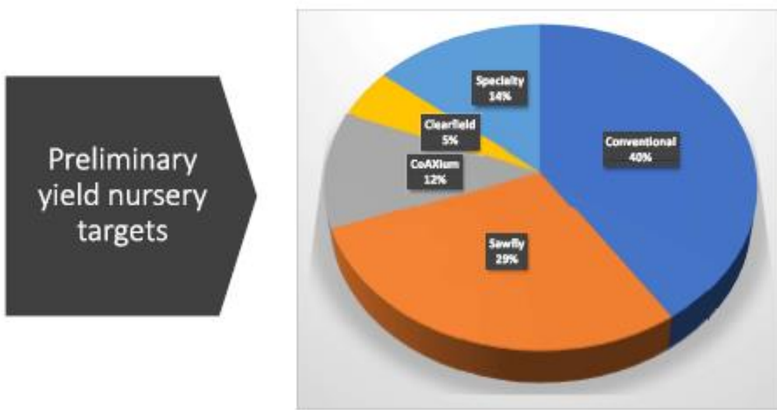
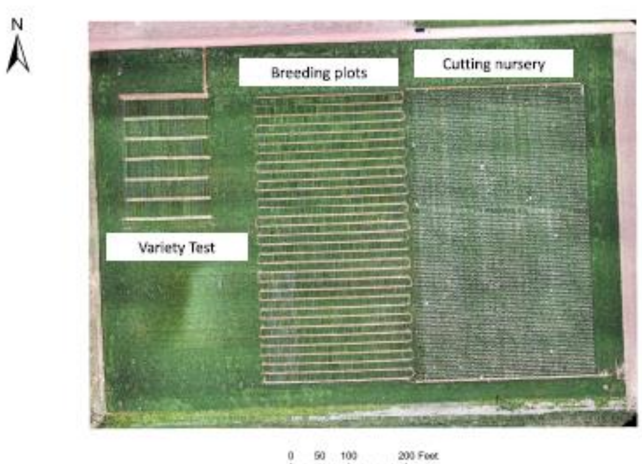
Wheat Stem Sawfly Research

Dr. Esten Mason

Associate Professor and Wheat Breeder
Department of Soil and Crop Sciences, Colorado State University

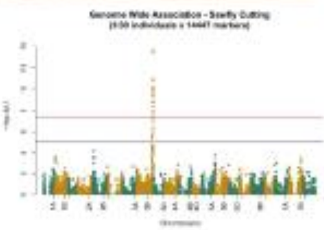




Plowing into the future – solid stem and cutting nursery

Sawfly resistance phenotyping

1. Molecular marker analysis
    - Qss.msub-3BL, Sst1
    - Potentially 6,000 lines per year
2. Stem dissection
    - 5-25 scale
    - ~300 samples per year
3. Sawfly cutting rating
    - 1-9 scale
    - ~19,000 lines screened in Akron in 2021



New sawfly resistant lines

- Two hard red winter wheat lines released this summer
    - 'Amplify SF' (CO16SF027)
        - Bearpaw/Antero//Antero
        - Marketed under the PlainsGold brand
        - Solidness rating = 16.5
        - 50,000 lbs foundation seed went to growers for 2022
    - CO16SF070
        - Antero/Judee//Antero
        - Solidness rating = 14.5
        - 18,000 lbs foundation seed available - Montech
- Hard white winter wheat for potential release this summer
    - CO18SFO009W
        - Bx7oe locus = strong bake mix time
        - Warhorse/Breck//CO1205028
        - Solidness rating = 15.3
        - 30 acres of foundations seed in 2022

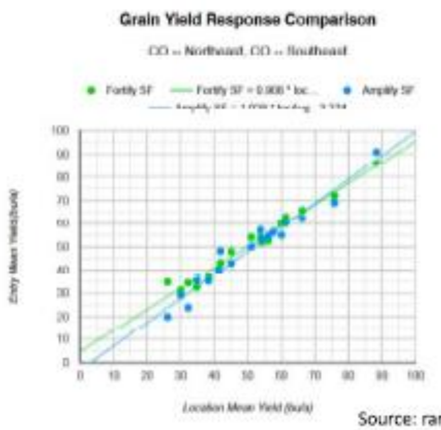
Entry	Cutting	Solidness	Solidness observations
Amplify SF	2.7	16.5	20
CD16SF070	4.1	14.5	31
CD18SF0009W	4.2	15.3	10
Fortify SF	2.7	12.3	47
Avery	7.9	5.7	11
Breck	7.6	6.8	11
Byrd	8.1	6.6	25
Canvas	6.6	7.5	7
Crescent AX	7.7		
Guardian	7.1	8.3	4
Kivari AX	6.3		
Langin	7.4	5.9	22
Monarch	5.8		
Snowmass 2.0	6.3	5.9	11
Whistler	7.4	6.4	6

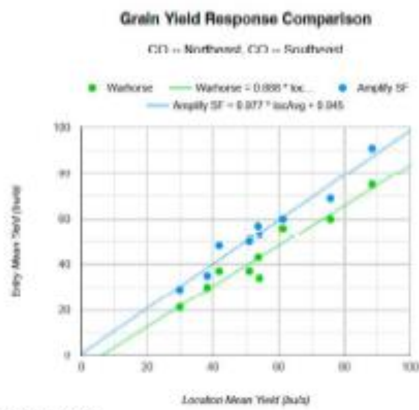
Data summary for semi-solid lines and hard red winter wheat check varieties for wheat stem sawfly cutting rating and solidness from 2019-2021

Entry	2021 CSU Elite Avg Yield w/o WSS	Avg Yield w/ WSS	Avg TestWt w/o WSS	Avg TestWt w/ WSS	Avg Cutting
Amplify SF	63.7	55.6	55.3	55.6	2.8
CO16SF070	61.8	53.0	53.3	53.0	3.7
CO18SFD009W	66.5	55.4	56.4	55.4	4.0
Fortify SF	64.3	55.0	55.0	55.0	2.9
Avery	63.2	54.5	54.1	54.5	6.3
Breck	66.3	56.0	56.6	56.0	7.0
Byrd	67.1	53.9	54.9	53.9	6.2
Canvas	66.1	53.3	55.2	53.3	3.9
Crescent AX	66.1	55.2	55.3	55.2	6.7
Guardian	63.6	53.9	55.4	53.9	5.5
Kivari AX	65.8	53.0	53.8	53.0	4.6
Langin	66.9	53.3	54.2	53.3	6.6
Monarch	68.3	53.0	54.7	53.0	4.4
Snowmass 2.0	69.1	53.9	55.7	53.9	4.4
Whistler	63.9	52.6	53.8	52.6	4.8
Average	66.0	53.9	54.9	53.9	5.5
Locations	8	3	8	3	2

Summary of semi-solid lines and other entries in the 2021 CSU Elite Trial in the presence or absence of wheat stem sawfly (WSS).

Head-to-head comparisons





Source: ramwheatdb.com

Solid stem+ CoAXium

- 28 lines selected from Akron Cutting nursery
- Unknown response to Aggressor
- If suitable line(s) are identified
  - 2023: Multilocation testing
  - 2024: Variety test and/or small Yuma increase
  - 2025: Release with limited seed availability
- Wildcard
  - CO20009RA
  - Spur/CO11D1767//Incline AX
  - Tolerant to Aggressor
  - Unknown stem solidness
  - 2022 testing in 7 locations and seed increase
  - Could go to variety test in 2023 and potentially cut 1-2 years off depending on seed quantity and performance

ENTRY	ID	PEDIGREE	Color	SOURCE
1	CO21SF272RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 94-1
2	[illegible]	[illegible]	R	Akron HR 94-2
3	CO21SF274RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 94-3
4	CO21SF021RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 94-4
5	CO21SF276RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 94-5
6	CO21SF266RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 95-1
7	CO21SF267RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 95-2
8	CO21SF275RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 95-3
9	CO21SF271RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 95-4
10	CO21SF020RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 95-5
11	CO21SF273RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 95-6
12	CO21SF270RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 95-7
13	CO21SF268RA	LCS Fusion AX/CO15SFO097//Canvas	R	Akron HR 95-8
14	CO21SF236RA	CO16SF032/Crescent AX	R	Akron HR 96-1
15	CO21SF237RA	CO16SF032/Crescent AX	R	Akron HR 96-2
16	CO21SF263RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-1
17	CO21SF260RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-10
18	CO21SF255RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-11
19	CO21SF256RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-12
20	CO21SF190RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-13
21	CO21SF258RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-2
22	CO21SF262RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-3
23	CO21SF265RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-4
24	CO21SF259RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-5
25	CO21SF264RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-6
26	CO21SF257RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-7
27	CO21SF261RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-8
28	CO21SF191RA	CO15SFO088/Battle AX//CO16SF075	R	Akron HR 97-9

National Association of Wheat Growers

Wheat Resiliency Initiative

Wheat Stem Sawfly - $1.30M

Wheat Stem Sawfly (WSS) is no longer just a problem in Montana and western North Dakota. WSS can now affect **42 million acres of winter wheat** in CO, KS, MN, MT, NE, SD and WY. Currently, total losses are estimated to be **$350M** annually. Development of **resistant varieties** that are adapted to the southern Great Plains and the development of **biological and cultural controls** are needed. Sawfly research hubs will be established in spring and winter wheat growing regions.

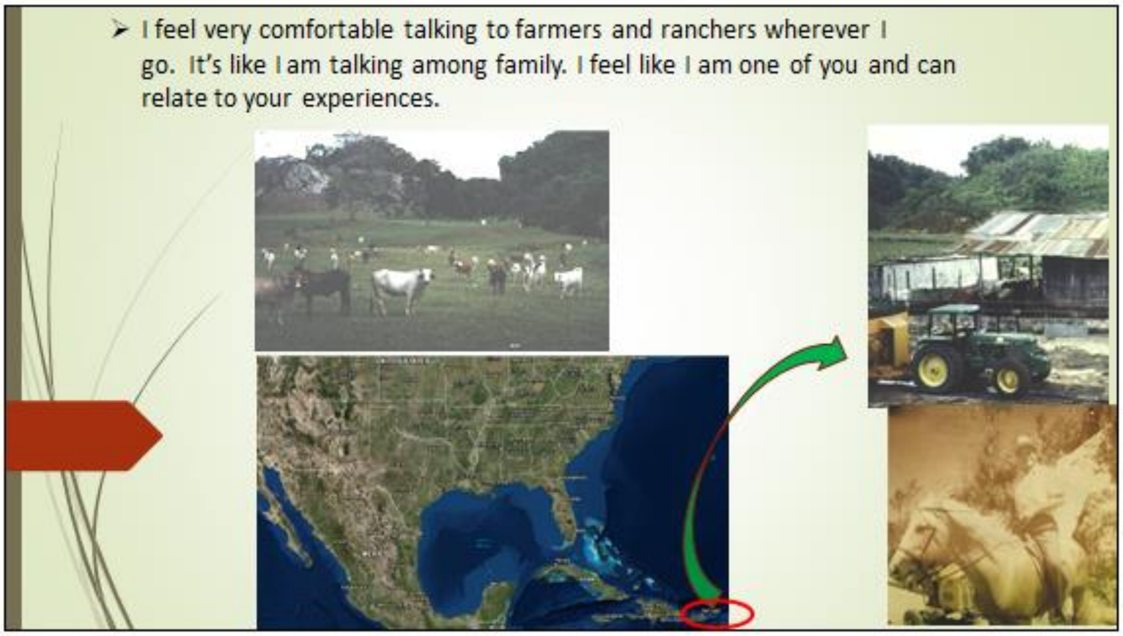
Wheat Stem Sawfly

As part of its life cycle, the Wheat Stem Sawfly trims heads off of wheat plants causing ***nearly 100% yield loss*** in affected areas across the Durum, Hard Red Winter and Hard Red Spring wheat growing regions. Changing weather patterns have established Sawfly across wheat acres in CO, KS, MN, MT, NE, SD and WY . Breeding efforts will focus on the solid stems and other mechanisms of genetic resistance.

Intensifying Row Spacing, Irrigated Corn

Dr. Jorge Delgado

Research Soil Scientist
USDA-ARS, Soil Management & Sugar Beet Research Unit, Fort Collins, CO



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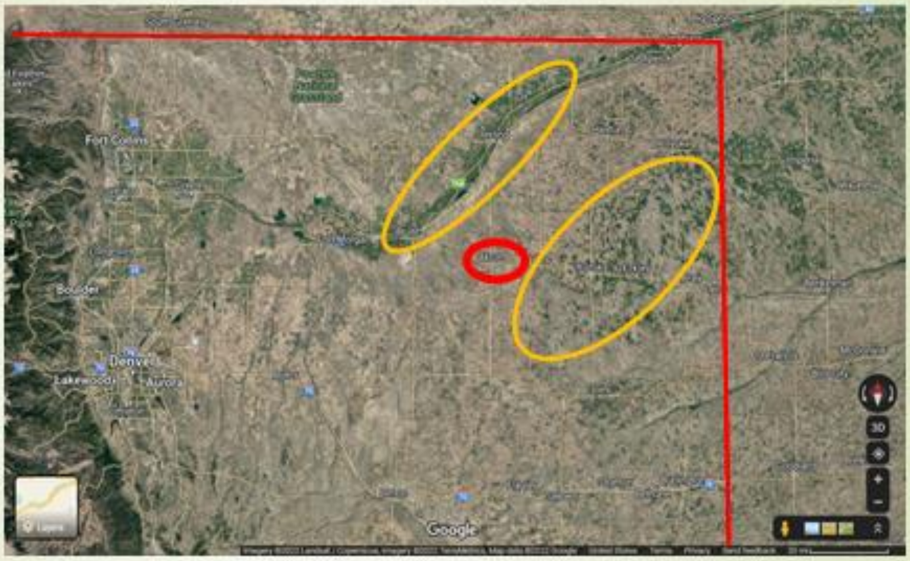

3

Use of Narrow Rows in Sprinkler-Irrigated Corn Systems to Increase Grain Yields, Aboveground Biomass, and Water and Nitrogen Use Efficiencies

Jorge A. Delgado, Bradley Floyd,
Amber D. Brandt and Robert D'Adamo

USDA-ARS, Fort Collins, CO

4

agronomy MDPI

Article

Use of Narrow Rows in Sprinkler-Irrigated Corn Systems to Increase Grain Yields, Aboveground Biomass, and Water and Nitrogen Use Efficiencies

Jorge A. Delgado *, Bradley Floyd, Amber D. Brandt and Robert D'Adamo

Soil Management and Sugar Beet Research Unit, USDA Agricultural Research Service, Fort Collins, CO 80526, USA; bradley.floyd@usda.gov (B.F.); amber.brandt@usda.gov (A.D.B.); robert.dadamo@usda.gov (R.D.)
* Correspondence: jorge.delgado@usda.gov

Abstract: Narrow rows and optimum nitrogen applications are effective best management practices (BMPs) to enhance crop yield in an economically viable way. In a set of four studies, we aimed to compare the traditional method of planting (TMP) in wider rows (76.2 cm) with a lower plant population (84,600 seeds ha^{-1}) against a new BMP of planting in narrow rows (38.1 cm) with a higher plant population (158,000 seeds ha^{-1}). Implementation of the BMP resulted in 29.9 Mg ha^{-1} of dry matter (DM) silage, which was 42.5% higher than the 21.0 Mg ha^{-1} observed with the TMP. The p-values for the BMP versus TMP silage comparisons were $p < 0.05$, $p < 0.05$ and $p < 0.001$ for studies 2, 3, and 4, respectively, showing the significantly higher production with the BMP. Silage production water use efficiency (WUE) and agronomic nitrogen use efficiency (AE) were also higher with the BMP in studies 2, 3 and 4. The average harvested grain DM of the three BMP studies (9.9 Mg ha^{-1}) was 9.5% higher than the 9.0 Mg ha^{-1} harvested grain DM with the TMP. The BMP of narrow rows with higher plant populations increases silage and grain production in sprinkler-irrigated systems.

Keywords: nitrogen fertilizer; nitrogen use efficiencies; silage production; water use efficiencies; *Zea mays* L.

check for updates

Citation: Delgado, J.A.; Floyd, B.; Brandt, A.D.; D'Adamo, R. Use of Narrow Rows in Sprinkler-Irrigated Corn Systems to Increase Grain Yields, Aboveground Biomass, and Water and Nitrogen Use Efficiencies. *Agronomy* **2022**, *12*, 92. https://doi.org/10.3390/agronomy12010092

1. Introduction

With over 90 million acres planted in the United States, corn (*Zea mays* L.) may well

5

Delgado et al. (2022)

Table 1. Summary of the main treatments and management factors in the four independent studies comparing the traditional method of planting (TMP) in 76.2 cm rows with a lower plant population to the best management practice (BMP) of planting in 38.1 cm (narrow) rows with a higher plant population *.

	Studies			
Factor	Study 1 ←	Study 2 ←	Study 3 ←	Study 4 ←
Planting density (seed ha^{-1})	92,300 (37,300) seeds ha^{-1} with BMP 92,300 (37,300) seeds ha^{-1} with TMP	184,500 (74,700) seeds ha^{-1} with BMP 92,300 (37,300) seeds ha^{-1} with TMP	184,500 (74,700) seeds ha^{-1} with BMP 92,300 (37,300) seeds ha^{-1} with TMP	184,500 (74,700) seeds ha^{-1} with BMP 92,300 (37,300) seeds ha^{-1} with TMP
Variety	Channel 193-53 STXRIB	Channel 193-53 STXRIB	Channel 192-10 STXRIB	Channel 192-10 STXRIB
N rates (kg ha^{-1})	0, 202, 246 and 314	0 and 202	0 and 202	157
Plot size	4.6 m × 14.6 m	4.6 m × 14.6 m	4.6 m × 14.6 m	20 m × 37.5 m

Note: Above numbers in parenthesis are the planting densities in seeds per acre.

6

6/22/2021

15-inch rows ➔

30-inch rows ➔

7

9/8/2021

15-inch rows

8

9/8/2021

30-inch rows

9

Delgado et al. (2022)

Table 3. Differences in total biomass silage and harvested grain (HG) mean dry weight yields (Mg ha^{-1}) of corn grown in the small plots (study 2) during 2019 under different row spacing systems and nitrogen rates ¶.

	0 Applied N		202 kg ha^{-1} Applied N		Spacing Levels §		Nitrogen Levels *	
Plant Compartment	38.1 cm $^{\beta}$ ROWS	76.2 cm $^{\beta}$ Rows	38.1 cm $^{\beta}$ Rows	76.2 cm $^{\beta}$ Rows	38.1 cm $^{\beta}$ Rows $^{¥}$	76.2 cm $^{\beta}$ Rows $^{¥}$	0 Applied N $^{¥}$	202 kg ha^{-1} Applied N $^{¥}$
Silage (Mg ha^{-1})	13.9 (6.2)	10.1 (4.5)	26.4 (11.8)	20.6 (9.2)	20.1 $^{¥}$ (9.0)	15.3 $^{¥}$ (6.8)	12.4 ‡ (5.5)	24.1 ‡ (10.8)
HG (Mg ha^{-1})	6.2 (117.0)	4.5 (84.9)	9.5 (179.3)	8.1 (152.8)	7.9 $^{¥}$ (149.1)	5.9 $^{¥}$ (111.3)	5.4 ‡ (101.9)	8.9 ‡ (167.9)

Note: Above numbers in parenthesis are silage in tons/acre, and HG in bushels/acre, respectively.

¶ Plant compartments were collected at physiological maturity (R6-black layer), except harvested grain, which was collected when grain water content was at 15.5%. $^{\beta}$ In 2019, planting densities were 158,000 seeds ha^{-1} in the 38.1 cm rows and 84,600 seeds ha^{-1} in the 76.2 cm rows. ¥,‡ Within a plant compartment, treatments with different symbols are different at ¥ $0.05 > p \geq 0.01$; ‡ $p < 0.001$. § Mean over spacing levels; * Mean over N levels.

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Delgado et al. (2022)

Table 5. Differences in total biomass silage and harvested grain (HG) mean dry weight yields ($Mg\ ha^{-1}$) of corn grown in the large, paired strip plots during 2020 under different row spacing systems (study 4) ¶.

	38.1 cm Rows β			76.2 cm Rows β			
Plant Compartment	Mean Yield ($Mg\ ha^{-1}$)	S.D. Yield ($Mg\ ha^{-1}$)	n	Mean yield ($Mg\ ha^{-1}$)	S.D. Yield ($Mg\ ha^{-1}$)	n	Paired-t p value
Silage	35.2 (15.7)	1.5 (0.67)	4	20.6 (9.2)	1.7 (0.76)	4	<0.001
HG	9.7 (183.0)	0.5 (9.4)	4	8.9 (167.9)	0.9 (17.0)	4	0.16

Note: Above numbers in parenthesis are silage in tons/acre, and HG in bushels/acre, respectively.

¶ Plant compartments were collected at physiological maturity (R6-black layer), except harvested grain, which was collected when grain water content was at 15.5%. β In 2020, planting densities were 158,000 seeds ha^{-1} in the 38.1 cm rows and 84,600 seeds ha^{-1} in the 76.2 cm rows.

11

- At $6.00 per bushel and $80 per ton of hay, a farmer with 1,000 acres will have an additional $170,000 (results from studies 2, 3 &4) to $353,000 (results from studies 5 & 6).
- Even at $3.00 per bushel and $80 per ton of hay, with a 10% lower response, a farmer with 1,000 acres will have an additional $99,000 (results from studies 2, 3 &4)to $195,000 (results from studies 5 & 6).

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Conclusions

- The BMP of narrow rows with higher plant populations increases silage and grain production in sprinkler-irrigated systems.
- Water use efficiencies and agronomic nitrogen use efficiencies for silage and harvested grain production were significantly higher with the BMP of planting in narrow rows with higher plant populations.

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Thank You!

14

Sorghum Variety Trials

Sally Jones-Diamond

Director – Crops Testing Program
Department of Soil and Crop Sciences, Colorado State University

1

2

Akron Trial on Aug 9th

- Planted May 28th
- Applied 49 lb/ac of N and 14 lb/ac of P
- Good plant stands and weed control
- Avg yield was 62 bu/ac, high was 75 bu/ac
- Avg. 73 days to bloom (Aug 9th)
- Good test weight due to long season.
- One entry clearly not adapted (very late maturity)

3

Brand	Hybrid	Grain Yield[a]	Yield	2-Year Avg. Yield	Test Weight	Emerged Plant Population	50% Bloom	Maturity Group[b]	Grain Color
		bu/ac	% of test avg.	bu/ac	lb/bu	plants/ac	days after planting		
Golden Acres	GA 2730B	**74.7**	119%	72	59	42,000	71	ME	Bronze
Hoegemeyer Seed	H6020	**72.6**	116%	-	59	41,000	68	ME	Red
Dekalb	DKS29-28	**71.7**	115%	76	59	44,800	71	E	Bronze
Golden Acres	GA 2620C	**71.7**	115%	76	59	32,900	71	ME	Cream
Sorghum Partners	SP 31A15	**70.8**	113%	73	57	38,600	72	ME	Bronze
Alta Seeds	ADV G1329	**70.5**	113%	-	58	32,300	71	E	Cream
Dyna-Gro Seed	M59GB57	**69.9**	112%	72	59	36,100	67	E	Bronze
Channel Seed	5B27	68.7	110%	-	58	41,500	65	ME	Red
Dyna-Gro Seed	M59GB94	68.7	110%	66	58	31,200	74	E	Bronze
Alta Seeds	AG1201	67.2	107%	-	58	34,700	70	E	Red
Dekalb	DKS28-05	65.7	105%	71	58	40,500	68	E	Bronze
Dekalb	DKS29-95	65.4	104%	-	58	37,400	72	E	Dark Red
Golden Acres	GA 1510C	65.4	104%	-	58	43,400	69	E	Cream
Channel Seed	5C76	64.5	103%	-	60	34,800	73	ME	Cream
Warner Seed	W5501	64.2	103%	-	58	37,000	67	E	Bronze
Dyna-Gro Seed	GX20973	63.9	102%	-	60	34,400	71	ME	Bronze
Sorghum Partners	K5310	63.9	102%	-	59	28,700	71	ME	Bronze
Alta Seeds	AG1101	62.4	100%	-	58	40,200	66	E	Red
Dyna-Gro Seed	M60GB88	62.1	99%	70	58	39,600	74	ME	Bronze
Sorghum Partners	SP 43M80	62.1	99%	66	59	30,200	73	ME	Bronze
Dyna-Gro Seed	M54GR24	58.8	94%	67	59	37,200	65	E	Red
Alta Seeds	ADV G1120IG	58.2	93%	-	56	31,200	86	ME	Red
Dyna-Gro Seed	M60GB31	57.0	91%	41	58	28,000	81	ME	Bronze
Dekalb	DKS27-80	56.7	91%	-	59	40,700	68	E	Bronze
Sorghum Partners	251	55.2	88%	-	59	35,100	65	E	Red
Sorghum Partners	SP 25C10	54.6	87%	61	60	37,900	66	E	Cream
Alta Seeds	ADV G1153	53.7	86%	-	57	30,600	86	ME	Red
Alta Seeds	ADV XG015IG	12.9	21%	-	54	32,900	111	E	Red
Average		**62.6**		**68**	**58**	**36,200**	**73**		
[a]LSD (.30)		5							
[a]LSD (.05)		10							

4

Led by Dr. Geoff Morris

- Looking at novel and adaptive sorghum traits to provide to sorghum breeders
- Trials at Akron screening lines to look for improved post-flowering drought tolerance
  - Stay green
  - Limited transpiration

5

Herbicide Technologies (Sorghum)

igrowth® from Alta Seeds (Advanta)

- Companion herbicide by UPL
  - IMIFLEX™ (Imazamox, group 2 ALS inhibitor)
- Pre- or post-emergence control of broadleaf and grass weeds and longer residual
- Seed costs ~$229-$249/bag MSRP
- Herbicide costs ~$2.97/oz
  - Apply PRE at 9 oz/ac and in most cases with an acetamide herbicide (Group 15)

  OR
  - Apply POST at 6 oz/ac following an acetamide PRE treatment

Slide credit: Dr. Brent Bean, Sorghum Checkoff

6

Herbicide Technologies (Sorghum)

Double Team™ from S&W Seed (Sorghum Partners)

- Companion herbicide by ADAMA
  - FirstAct™ (quizalofop, group 1 ACCase inhibitor)
- Pre- or post-emergence control of broadleaf and grass weeds
- Seed costs ~$299/bag MSRP
- Herbicide costs ~$1.00/oz
  - Common recommendation to apply to >11" sorghum at 10 oz/ac
  - Grass resistance to ACCase is relatively low compared to ALS

Slide credit: Dr. Brent Bean, Sorghum Checkoff

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Herbicide Technologies

Colorado Summary

PRE

ImiFlex 9 oz/A provided significantly better sandbur control (58%) than Dual or Warrant 70 DAT

POST

ImiFlex, Zest and FirstAct all provided 90% control of 2-4 lf sandbur 32 DAT

The addition of 2,4-D with FirstAct decreased control of foxtail and barnyardgrass by 20%

Slide credits: Eric Westra and Todd Gaines, CSU
Dr. Brent Bean, Sorghum Checkoff

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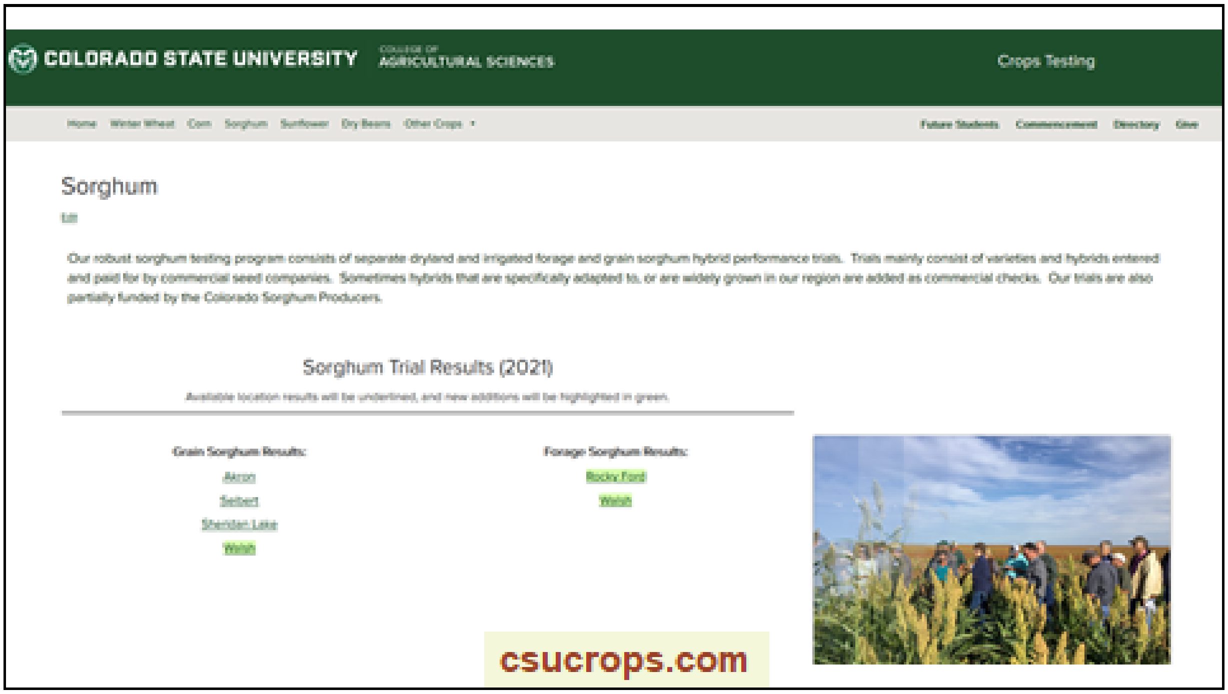

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Thank you

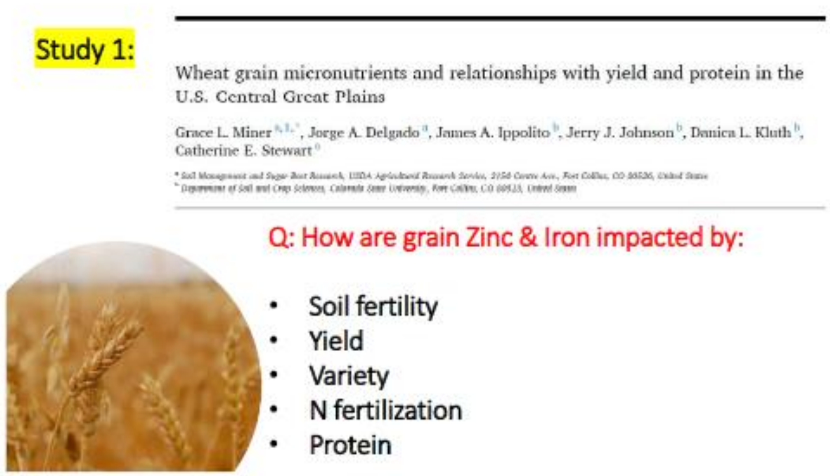
Colorado State University

10

ACR (Alternative Crop Rotations) Study Analysis

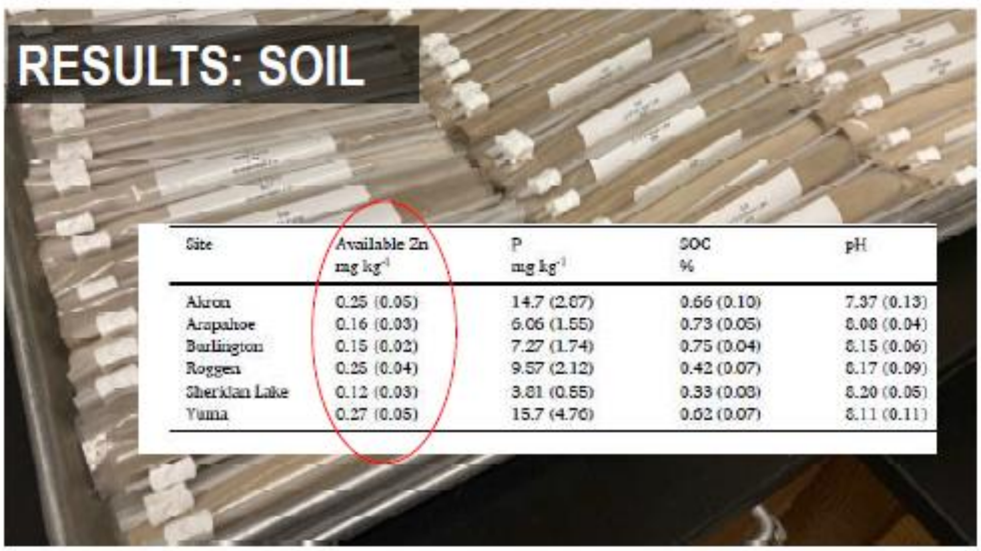
Dr. Grace Miner

Postdoctoral Scientist
USDA-ARS, Soil Management & Sugar Beet Research Unit, Fort Collins, CO

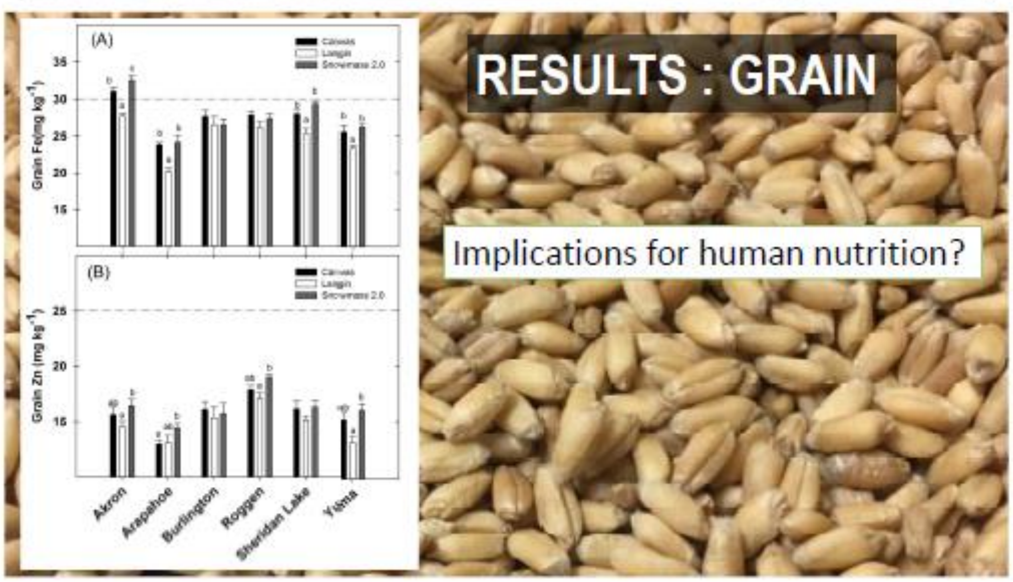


METHODS

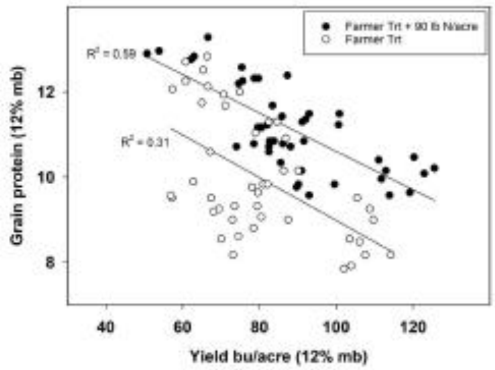
- 6 sites
- 2 N rates (Farmer Trt, FT + 90 N lb N/acre)
- 3 Varieties (Canvas, Langin, Snowmass 2.0)
- Soil sample pre-plant Fall 2018; Harvest 2019



Site	Available Zn $mg\ kg^{-1}$	P $mg\ kg^{-1}$	SOC %	pH
Akron	0.25 (0.05)	14.7 (2.07)	0.66 (0.10)	7.37 (0.13)
Arapahoe	0.16 (0.03)	6.06 (1.55)	0.73 (0.05)	8.08 (0.04)
Burlington	0.15 (0.02)	7.27 (1.74)	0.75 (0.04)	8.15 (0.06)
Roggen	0.25 (0.04)	9.57 (2.12)	0.42 (0.07)	8.17 (0.09)
Sheridan Lake	0.12 (0.03)	3.81 (0.55)	0.33 (0.08)	8.20 (0.05)
Yuma	0.27 (0.05)	15.7 (4.76)	0.62 (0.07)	8.11 (0.11)

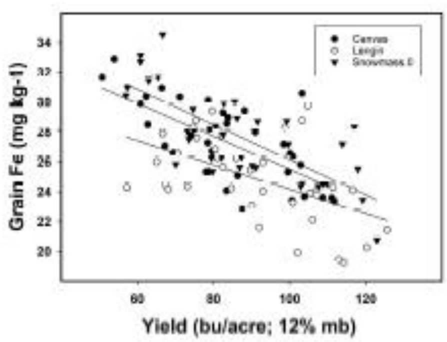


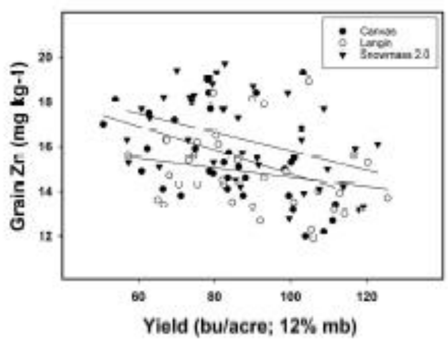
RESULTS: PROTEIN-YIELD



- Only a small yield boost of additional N at a few sites
- Improved grain protein, but at what cost economically, environmentally?

RESULTS: IRON/ZINC YIELD





- Very nominal varietal differences
- Larger yield dilution of Iron than of Zinc

CONCLUSIONS

- Extremely low available soil Zinc at all sites! Updated and refined research on what constitutes 'sufficiency' for micronutrients is needed
- It is possible Zn is limiting yields in hidden ways – another role of SOC?
- Complex tradeoffs between productivity and nutritional quality

Study 2: # Quantifying precipitation, temperature, and management impacts on wheat yields

Grace L. Miner[a*], Catherine E. Stewart[a], Merle F. Vigil[a], David Poss[b], Scott D. Haley[c],

Sally Jones-Diamond[c], and Esten Mason[c]

Q 1: How have precipitation and temperatures historically impacted wheat yields at Akron?

Q 2: How do no-till/fallow mitigate weather impacts on yield?

Q 3: Do high-yielding varieties show lower heat tolerance than low-yielding varieties?

METHODS

- Yield data from USDA ARS ACR plots (1993 – 2015); wheat in 7 different rotations (no-till, conv. Till, with and without fallow)
- Robust on-site weather data aggregated into monthly intervals of precipitation or temperature exposure
- Yield data from CSU Variety trials
- Statistical model selection

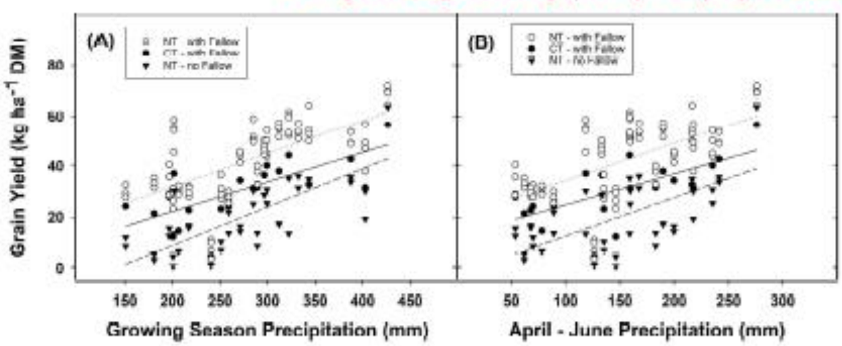
RESULTS

Q 1: What factors have historically impacted wheat yields at Akron?

Spring precipitation as predictive of wheat yields as growing season precipitation

Q 2: How do no-till/fallow mitigate climate impacts on yield?

We thought no-till might have stronger yield response to precipitation, but don't see this.

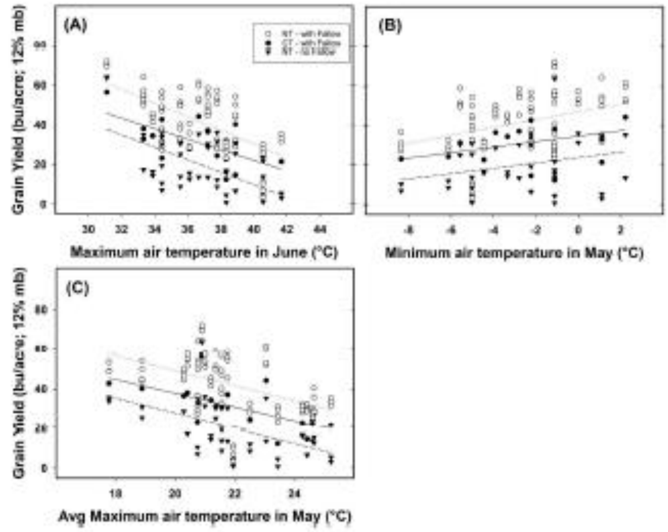


For panel A, model $R^2 = 0.65$. For panel B, model $R^2 = 0.60$

RESULTS

Q 1: What weather factors have historically impacted wheat yields at Akron?

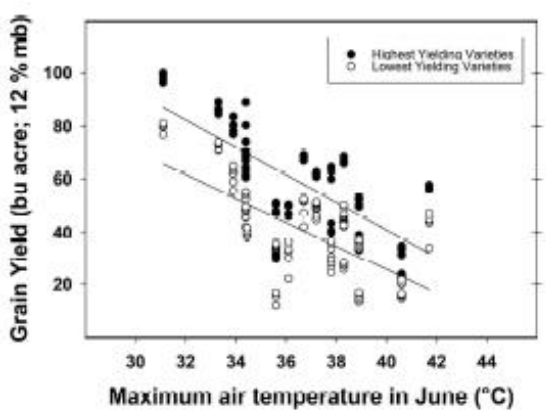
Maximum temperature in June as predictive of yields as precipitation



RESULTS

Q3: Do high-yielding varieties show lower heat stress tolerance than low-yielding varieties?

We find no evidence for this.



CONCLUSIONS

- Dryland agroecosystems are already operating at the extremes of precipitation and temperature
- Historic May and June daytime temperatures in eastern Colorado are already at or above optimum
- No-till and fallow inclusion represent management adaptation to this climate that have been historically critical to maintaining viable wheat yields and mitigating risk (Complex Trade-offs)
- We found no evidence for adaptation to heat stress via alternative variety selection, at least from historical breeding lines.

Setting the Stage: Akron's USDA Research Program

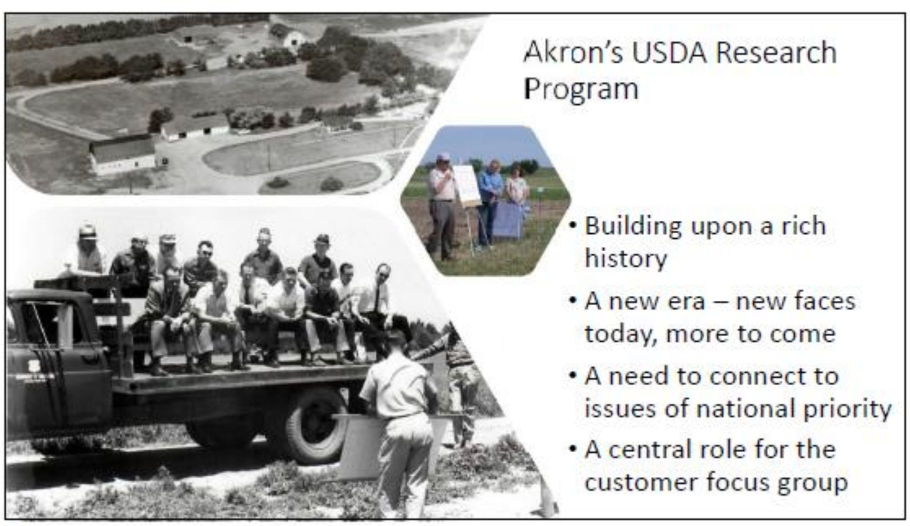
Pete Kleinman

Research Leader, Soil Scientist
USDA-ARS, Soil Management & Sugar Beet Research Unit, Fort Collins, CO

Kyle Mankin

Research Leader, Agricultural Engineer
USDA-ARS, Central Great Plains Research Station, Akron, CO
USDA-ARS, Water Management & Systems Research Unit, Fort Collins, CO

1



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Akron as key to Western Great Plains Dryland Production Systems

USDA NRCS's Western Great Plains Range and Irrigated Region (G)

USDA NRCS's Central Great Plains Winter Wheat and Range Region (H)

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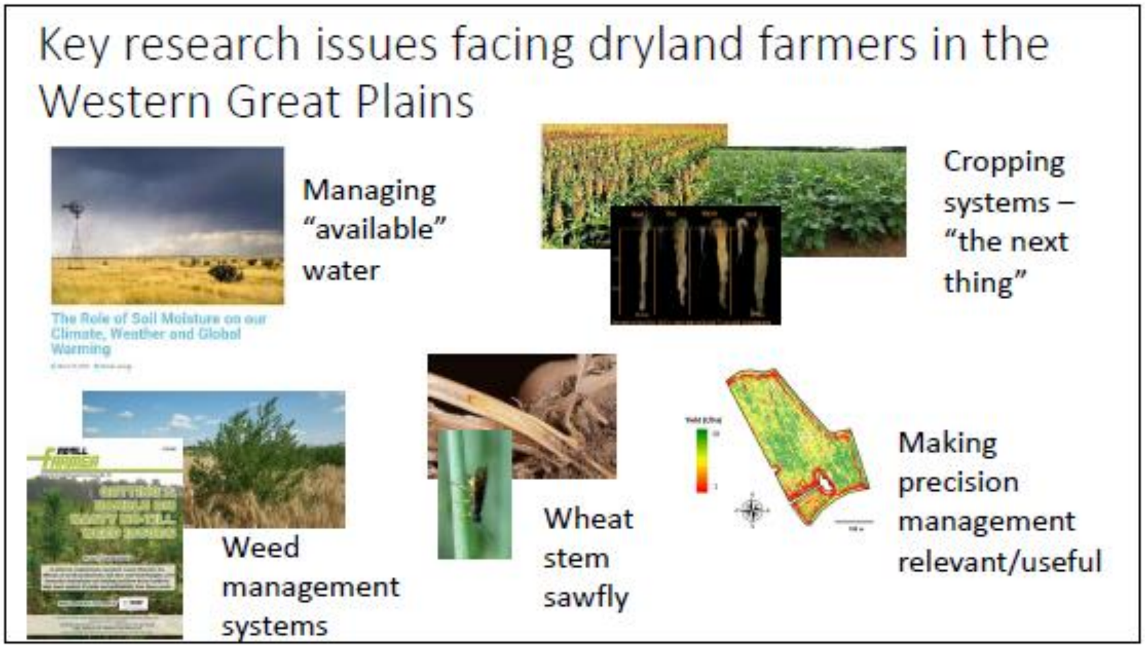
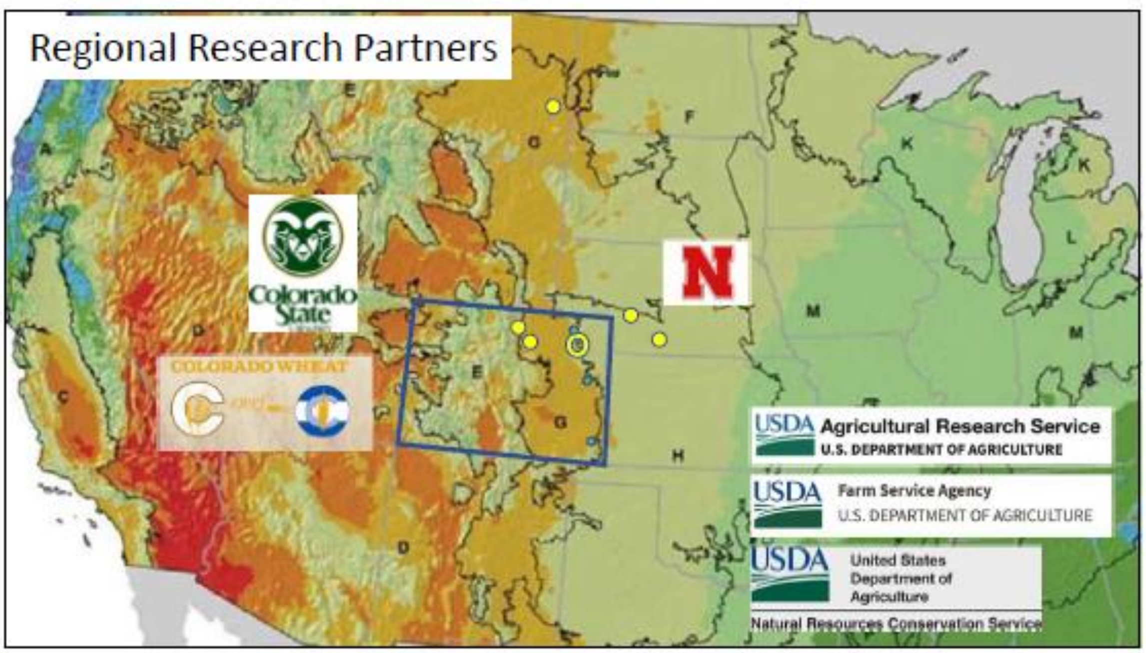

Key research issues facing dryland farmers in the Western Great Plains
Managing "available" water
The Role of Soil Moisture on our Climate, Weather and Global Warming
Cropping systems – "the next thing"
Weed management systems
Wheat stem sawfly
Making precision management relevant/useful

5


Regional Research Partners
Colorado State
COLORADO WHEAT
N
USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE
USDA Farm Service Agency
U.S. DEPARTMENT OF AGRICULTURE
USDA United States Department of Agriculture
Natural Resources Conservation Service

6

Knowledge co-production

expanding our research on farms

Share data from yield monitors

- Understand mechanisms
- Track long-term outcomes
- Explore new options

On farm monitoring, experiments and data sharing

Farm tours!

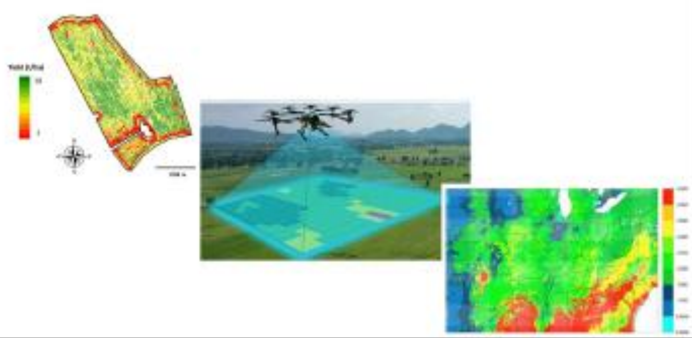
7

Getting value out of big data

- *"precision management"* isn't just about using variable rate equipment at fine scale
- It's about making all available data useful
- *Crop selection, managing to account for variability, forecasting*

"Big data"

- On-farm data sources
- Remote sensing
- Models



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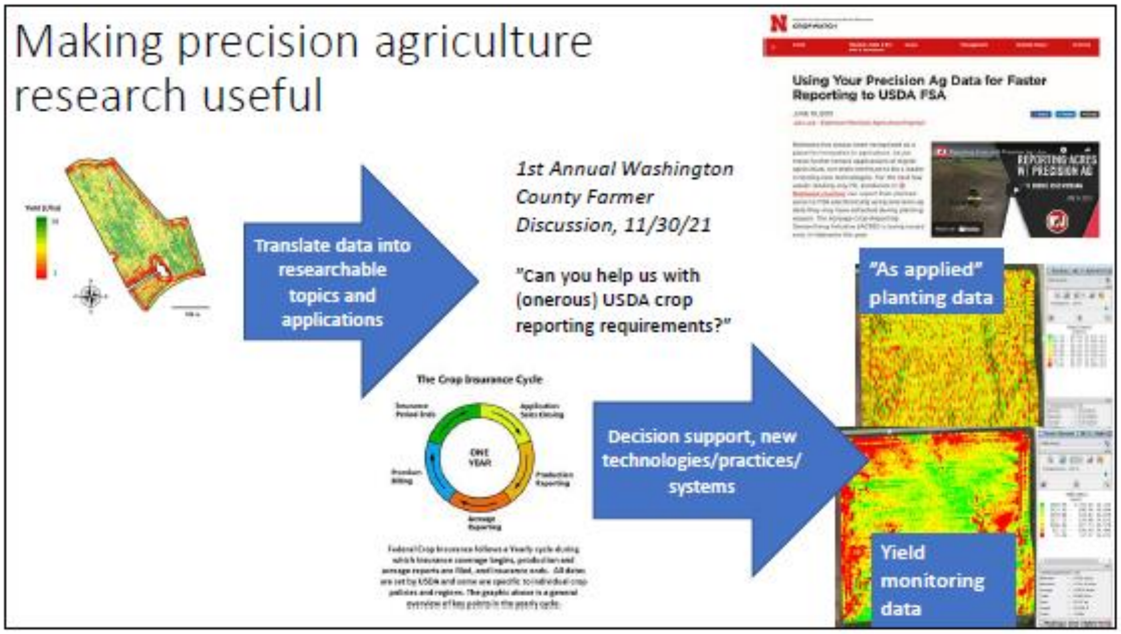
Making precision agriculture research useful
Translate data into researchable topics and applications
1st Annual Washington County Farmer Discussion, 11/30/21
"Can you help us with (onerous) USDA crop reporting requirements?"
Using Your Precision Ag Data for Faster Reporting to USDA FSA
The Crop Insurance Cycle
ONE YEAR
Decision support, new technologies/practices/ systems
"As applied" planting data
Yield monitoring data

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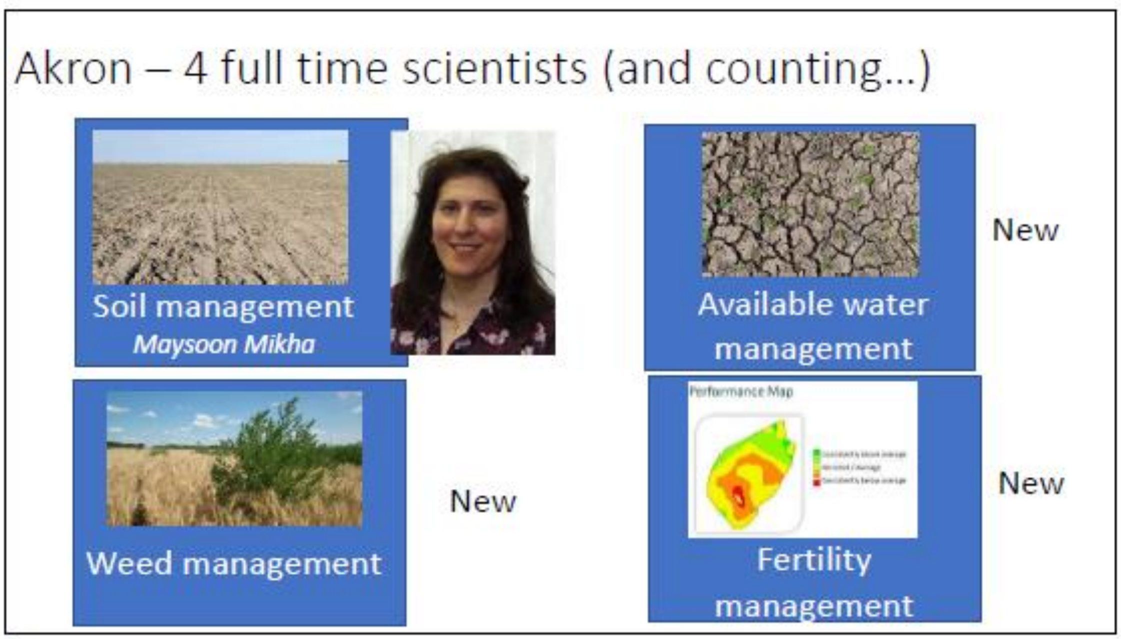
Akron – 4 full time scientists (and counting…)
Soil management
Maysoon Mikha
Available water management
New
Weed management
New
Performance Map
Fertility management
New

10

Akron Initiatives – bringing in new resources

Western "sentinel" network

– weather, soil, pests

Research farm of the future

- Akron as a trial ground for "smart" technologies

CARR – Fort Collins

- Daren Harmel, Director

Long Term Agroecosystem Research Network

- *sustainable intensification*
- *critical infrastructure*

11

Kyle Mankin

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Pete Kleinman

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12

Facilitated Discussion

Alan Linnebur

Chair, Akron Customer Focus Group

Notes:

- Keep our research local and unique. Like the integrated approach (soil-water-weed-nutrient).
- Precision ag: Can we make money *and* improve the environment?
- Akron/CARR economist: Economics of precision ag different for irrigated vs. dryland.
- What we know now vs. what we need to know.
- Have producer(s) participate in research meetings for a different perspective.
- 'Onboarding' new scientists by visiting producer's operations.
- Maximum Economic Yield (MEY) Club (initiated by Halvorson). 15-20 farmers met 1-2 times/month (in Winter) up to about 2008-09. One speaker/topic with feedback between producers and scientists. Look to stakeholders for topics (rate from a list). Rekindle this?
- Sandbur control is #1 issue now (millet).
- Changes in crops due to changes in weather pattern
- Communications. How to make research more easily available?
    - Field Day
    - Customer Focus meeting
    - MEY club meetings
    - Email – pass on research
    - PDI – Partnership & data innovations
    - Send publication website
- Use Customer Focus Group for input throughout research (planning, mid-project, interpretation). Include on hiring panel for new scientists? Maybe have producer-oriented seminar at Akron as part of interview process?
- Precision ag: Might be best at reduction inputs, increasing the bottom line. Where is my biggest bang for the buck from precision ag? Different for different sized operations.
- Farm based data: We don't need a lot, but can be selective with regard to the data we collect and locations of study sites. What base data best represents our goals? How do we get a baseline of data? How do we help the next generation?
- Need input from spectrum of operations (subsistence, 100 ac, 12,000+ ac).
- Climate at Akron takes longer for response to show up in data. Makes Akron research unique.

Immediate & pressing concerns:

- Water is the lid on yields while costs escalate. We've had a string of tricks, but now we need a new trick! What is it? What can I adopt that keeps me in business?
- Midwest-centric policy is not applicable here, but affects us (e.g., conservation programs). Akron can provide data that applies to our area's uniqueness.

- Variable rate seeding not really relevant (cost/ac low enough), but variable rate fertilization is critical (high fertilizer prices).
- Palmer Amaranth causing us to go backwards to tillage (also resistant kochia).
- Sustainability of farm. Mining micronutrients and losing soil C.
- Weather: you can do everything in your power and it can be gone due to drought, hail, etc.
- Risk management around weather. How to deal with the extremes. How do we make it rain???
- Millet research: breeding, marketing (market is issue), production practices. Systems approach.
- Wheat Stem Sawfly

2021 Publications

Published

Jones-Diamond, S., Asfeld, E., Johnson, J., Cabot, P., Fry, J., Tanabe, K., Bartolo, M., **Mankin, K.R.**, Difonzo, C., Roberts, R., Gutierrez-Castillo, D.E. 2022. **2021 Colorado corn variety performance trials**. Colorado State University Technical Report. https://webdoc.agsci.colostate.edu/csucrops/reports/corn/cornreport_2021.pdf

Mikha, M.M., Jin, V.L., Johnson, J.M., Lehman, R.M., Karlen, D.L., Jabro, J.D. 2021. **Land management effects on wet aggregate stability and carbon content**. *Soil Science Society of America Journal*. https://doi.org/10.1002/saj2.20333.

Maharjan, B., Panday, D., Blanco, H., **Mikha, M.M**. 2021. **Potential amendments for improving productivity of low carbon semi-arid soil**. *Agrosystems, Geosciences & Environment*. 4(3):1-10. https://doi.org/10.1002/agg2.20171.

Panday, D., **Mikha, M.M**., Sun, X., Maharjan, B. 2021. **Coal char effects on soil chemical properties and maize yields in semi-arid region**. *Agrosystems, Geosciences & Environment*. 4:1-10. https://doi.org/10.1002/agg2.20145.

Panday, D., **Mikha, M.M.**, Maharjan, B. 2021. **Coal char affects soil pH to reduce ammonia volatilization from sandy loam soil**. *Agrosystems, Geosciences & Environment*. 3:1-8. https://doi.org/10.1002/agg2.20123.

Submitted

Mikha, Maysoon M., and Marake, Makoala V. **Soil organic matter fractions and carbon distribution under different management systems in Lesotho, Southern Africa.** *Soil Science Society of America Journal*.

Ramírez, P.B., Calderón, F.J., Vigil, M.F., **Mankin, K.R.**, **Poss, D.**, Fonte, S.J. **Field-specific yield response to soil heterogeneity leads to substantial wheat yield variability in the Central High Plains.** *Soil Science Society of America Journal*.

Tatarko, J., Presley, D., **Mankin, K.R. Wind erosion potential from stover harvest in the Central Plains: Measurements and simulations**. *Soil and Tillage Research*.

Abstract for Meeting

Mikha, M.M., Barnard, D.B., Mankin, K.R. 2021. **Precision agriculture practices in dryland cropping system**. American Society of Agronomy Meeting, Salt Lake City, UT, November 7-10, 2021.